

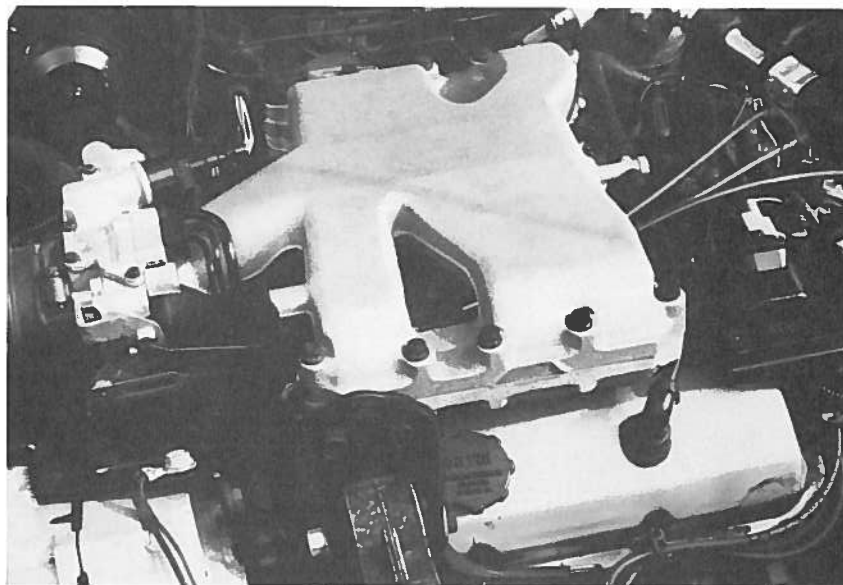
History

1

The 2.8-liter 60deg V-6 engine was designed by Chevrolet and introduced in the 1980 General Motors "X" cars, including the front-wheel-drive Chevrolet Citation, Pontiac Phoenix, Buick Skylark, and Oldsmobile Omega. It was intended to meet the needs of a changing automotive world; escalating fuel prices and federal fuel economy standards, tighter emission standards, smaller and lighter vehicles, and tighter powertrain "packaging" all set the tone for the development of this engine.

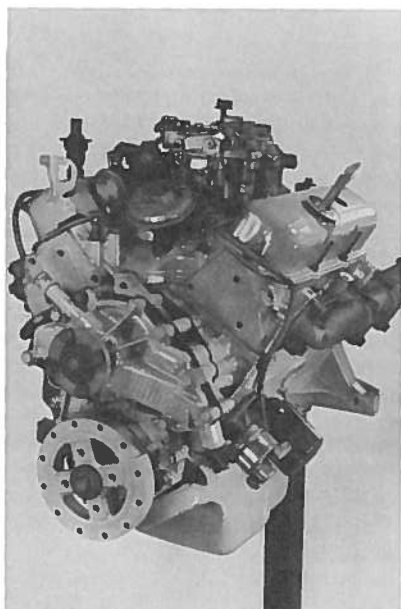
The engine's cylinder banks were offset 60deg from one another due to space limitations. The dimensions of the 1980 X-car were already agreed upon, so any new, optional engine GM might offer had to fit in the X-car's existing space.

Over the years, consumer acceptance of this workhorse grew, and it found a home in many General Mo-

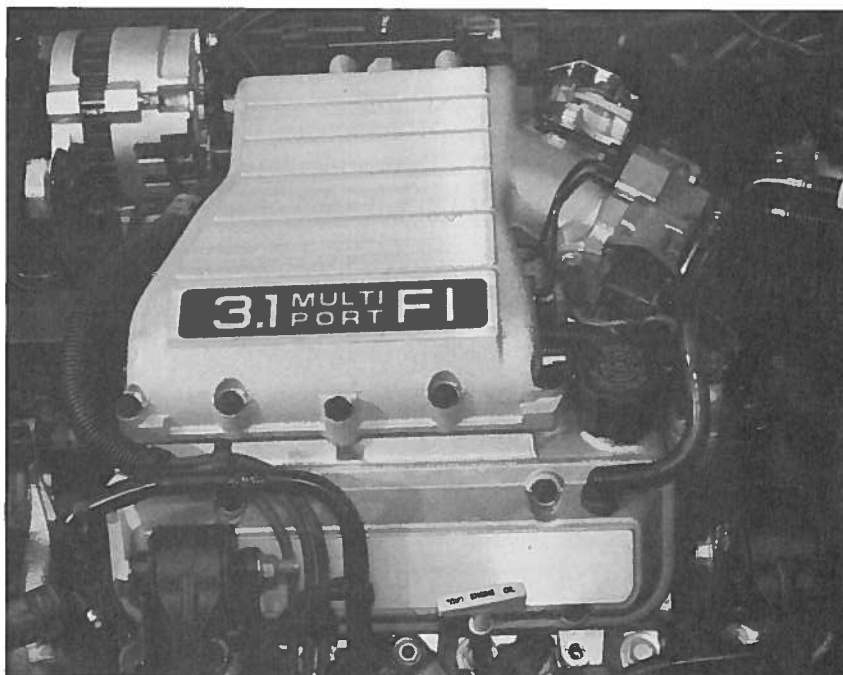


In 1985, Multi-Port Fuel Injection (MPFI) was introduced on the 2.8-liter V-6. It was used only on certain pas-

senger cars initially. Trucks made due with carburetors, though, after a time, throttle bodies were fitted.



The GM 60deg V-6 engine has proved to be an adaptable workhorse. Over the years, it has grown from 2.8-liter to 3.1-liter to 3.4-liter. It has also been fitted with a carburetor, three different fuel injection systems, and two types of ignition systems.



The "Generation II" version of the 60deg V-6 debuted in 1987. Available only in front-wheel-drive vehicles, its major fea-

tures were specially-designed aluminum heads with splayed valves and a Distributorless Ignition System (DIS).

tors vehicles—including Camaros, S-10 Blazers, Cimmarons, Firebirds, and Centurys, among others. It was even sold to Jeep and Isuzu for use in some of their four-wheel-drive vehicles and to Mercury Marine for in-board boat engine applications.

As time marched on, the 60deg V-6 grew larger and more sophisticated, its displacement increasing from the original 2.8-liters fed by a 2-barrel Rochester Varajet II carburetor to 3.1-liters in the 1990 model year and then to 3.4-liters for the 1993 model year. Later versions were fitted with one of three types of electronic fuel injection: throttle body injection (TBI), multi-port fuel injection (MPFI), or sequential fuel injection (SFI).

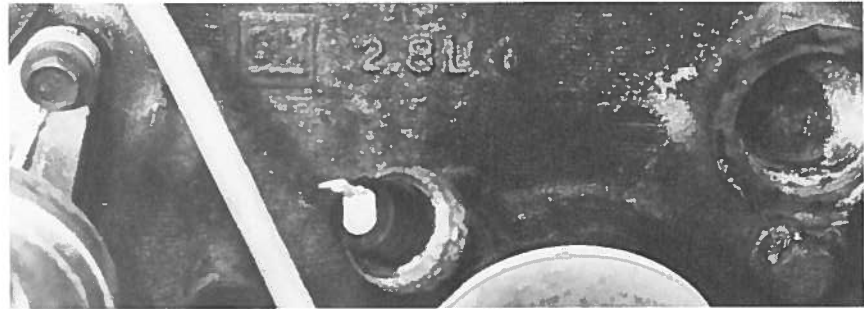
The engine was extensively improved in 1987, so much, in fact, that it was referred to as the "Generation II" engine. Improvements included aluminum cylinder heads with splayed intake and exhaust valves, revised intake porting, tighter operating clearances, distributorless ignition, a single serpentine accessory drive belt, and numerous engine appearance refinements. This engine is only available in front-wheel-drive vehicles.

In the 1991 model year, a 3.4-liter V-6 with dual overhead cams and four valves per cylinder was introduced. This took the 60deg V-6 from working class status to major league punch to the tune of 210nhp. Although this engine shares a number of features with its 3.1-liter predecessor, its cylinder block, cylinder heads, and related components are substantially different enough that it won't be covered in this book.

However, another 3.4-liter engine was introduced in the 1993 Camaro and Firebird. This engine is more closely related to its 3.1-liter father and consequently shares a number of the repair procedures covered in this book. This engine grew from the 3.1-liter as the result of an increase in bore diameter; it is rated at 160hp and 200lb-ft of torque. It was also the first of the 60deg V-6s to use a sequential fuel injection system (SFI) and an enhanced digital ignition system (DIS).

Differences between Front- and Rear-Wheel-Drive Engines

As you would imagine, the primary difference between engines used



The engine size is cast on the left-hand side of the block, almost directly above the oil filter mounting boss. The sides of

the 2.8-liter and 3.1-liter blocks are smooth compared to the external ribbing on the 3.4-liter.

Significant Model Year Changes Affecting Service 1980

- Introduction of the 2.8-liter (173ci) V-6
- 60deg angle between cylinder banks for packaging efficiency
- Designed for future displacement increases
- Short-stroke design (89mm bore, 76mm stroke)
- Firing order 1-2-3-4-5-6
- Cast-iron "small-valve" heads (1.60in intake, 1.30in exhaust)
- Flat-top aluminum pistons
- Fuel pump pushrod 12mm in diameter
- High-Energy Ignition (HEI) system
- Staged 2-barrel carburetor (Varajet II)
- Externally balanced cast crankshaft

1981

- Water pump removal does not upset timing cover seal
- Guide-mounted seal added to intake valve guide
- Early Fuel Evaporation (EFE) grid added underneath carburetor
- High-output version introduced, featuring:
 - Horsepower increase to 135 net hp
 - Piston height increased 0.020in
 - Compression increased to 9:1
 - Intake and exhaust valve diameters increased by 0.120in
 - Cross-drilled crankshaft main journals

1982

- Basically carried over from 1981
- First use in rear-wheel-drive vehicles
- Fuel pump pushrod diameter increased from 12mm to 16mm for all engines
- Rope-type rear main seal replaced by two-piece polyacrylate seal
- Front-mounted thermostat housing (rear-wheel-drive vehicles only)
- Engine-driven cooling fan (rear-wheel-drive vehicles only)
- Exhaust gas recirculation (EGR) valve located at rear of engine (rear-wheel-drive vehicles only)
- HEI distributor with separate coil (rear-wheel-drive vehicles only)

1984

- Basically carried over from 1983
- One-piece rear main seal (5mm wide) available for service
- Four-bolt right-hand motor mount

1985

- Engine introduced in "J"-cars (i.e. Cavalier, Cimmaron)
- Engine used in J-cars inclined further forward than in other vehicles
- "Thin" front cover, offset water pump, and 0.100in narrower timing set required
- Multi-port fuel injection (MPFI) system introduced:
 - One fuel injector per cylinder; sprays fuel directly into cylinder

chain

- Cold-start fuel injector
- Special throttle body
- High-pressure electric fuel pump
- Fuel pressure regulator
- Different cylinder head gaskets used with MPFI engines
- Pistons used with MPFI engines 0.020in taller
- Larger crankshaft main bearing journals introduced mid-year
- One-piece rear main seal (10mm wide) introduced mid-year
- O-ring used to seal main oil passage between oil pump and block
- Lower friction oil control rings
- Distributor downsized
- Intake plenum lower on J-cars to clear hood
- Serpentine accessory drive belt on some models

1987

- Generation II engine introduced in front-wheel-drive vehicles
 - Cylinder heads redesigned and cast in aluminum
 - Cylinder heads require dished pistons and thicker head gaskets with unique cooling holes
 - Cast-aluminum rocker arm covers
 - Splayed intake and exhaust valves
 - Guide-mounted seals used on both intake and exhaust valve guides
 - Valve stem seal, oil shedder, and shield discontinued
 - Valve lash adjustment procedure changed
 - Intake plenum reshaped for efficiency
 - Aluminum front cover and water pump housing
 - Direct Ignition System (DIS) replaces distributor (front-wheel-drive vehicles only), fires two spark plugs simultaneously
 - Oil pump driven by oil pump drive
 - Internally balanced crankshaft incorporates "reluctor" for DIS operation; ignition timing nonadjustable
 - Compression ratio increased to 8.9:1
 - Lower friction piston compression rings
- Model 700 TBI system introduced
- Serpentine accessory drive belt
- Internally balanced crankshaft used in engines fitted to rear-wheel-drive vehicles only
 - Cast with DIS reluctor, but DIS ignition not used
- One-piece oil pan gasket

1988

- Lathe-turned pistons
- Piston weight reduced from 600gm to 540gm, and then finally to 510gm
- Internally balanced crankshafts (rear-wheel-drive vehicles only)
- Multec fuel injectors replace earlier pintle-style injectors
- Speed density engine control system replaces mass air flow (MAF) sensor in J-cars

1990

- Displacement increased from 2.8-liter to 3.1-liter
- Stroke increased 8mm
- Uses dished pistons
 - 4mm shorter than 1989 model engines
 - Features low-tension piston rings
- Single-size pistons, main bearings, and rod bearings, eliminating need for different sizes of parts during service
- Fuel pump eccentric on camshaft eliminated
- Aluminum heads used on some models

1993

- 3.4-liter version introduced in Camaro and Firebird
- Bore increased 3.03mm
- SFI system introduced
- DIS enhanced; uses additional sensor at front of block
- Cylinder block upgraded to handle additional displacement

in front-wheel-drive vehicles and those used in rear-wheel-drive lies in how each is mounted. However, the cooling systems also differ. Since the end of the engine that normally drove the cooling fan had to be positioned to the side on front-wheel-drive vehicles, electric cooling fan(s) were required. To further accommodate this change in engine position, the thermostat housing was repositioned to the fly-wheel end of the engine.

Differences among Front-Wheel-Drive Engines

The main difference in front-wheel-drive vehicles is the location of their water pumps. In vehicles with large engine compartments, the water pump lies directly above the crankshaft. On Cavalier- and Beretta-sized cars, with their smaller engine compartments, the water pump was moved up and to the side of its "normal" location. These cars also use a lower-profile intake plenum, and their engines are inclined at a steeper angle to provide more hood clearance.

Should You Rebuild?

To rebuild or not to rebuild. That is the question. Does the engine before you really require a rebuild or just a new power steering pump. What, you might ask, does a power steering pump have to do with an engine rebuild? In a word, nothing. And that's precisely the point. A dying power steering pump can produce a knocking noise that's much like that made by a spun main bearing. If you pull the engine without first checking for other culprits (like that steering pump) you may find yourself wasting much time and money. Determine if the engine is the cause of a noise before you even *consider* rebuilding it. The same goes for poor performance and oil consumption, because several things other than the engine can cause these problems as well. Always remember to look beyond the engine before starting that "essential" engine rebuild.

How Maintenance Influences Engine Longevity

Just because an engine has traveled many miles doesn't mean it needs to be rebuilt. Regular maintenance has a major impact on engine life. If the engine oil and oil filter were changed every 3,000 miles and the air filter was changed every 10,000 miles, chances are good that the engine will run well over 100,000 miles before it requires any major service. GM's 60deg V-6 engine is so well-built that 200,000 miles before a rebuild is not out of the question. The type of driving the engine was subjected to also has a bearing on its life. Freeway driving is easier on the engine than stop-and-go operation or racing.

Other than an outright failure, oil consumption, noises, and poor performance are the three major factors that will dictate whether an engine should be rebuilt.

Generally speaking, if the engine burns less than 1qt of oil every 2,500 miles, exhibits no unusual noises, and performs well, it probably doesn't need to be rebuilt. On the other hand, if the engine swills oil like a drunken sailor or sounds like a

mariachi band, roll up your sleeves, get out your tools, and prepare to pump life into the undead.

The following sections will discuss the problems of oil consumption, abnormal noises, and abnormal and poor performance, and show you how to check for each.

Oil Consumption

Excessive oil consumption is a good reason to rebuild an engine. But how much is excessive? Some oil consumption is normal for all engines. According to GM, an engine doesn't have an oil consumption problem until it's burning 1qt of oil every 750 miles! Yet it's not unusual for a high-mileage GM 60deg V-6 in decent condition to use only 1qt of oil every 2,500 miles. Even if your engine is using more oil than this, it still may not require a rebuild. You must first determine if it's burning the oil, or just leaking it, before you think about rebuilding.

Use the Proper Oil

First thing to check: Are you using the correct weight oil? Use of the proper weight engine oil has a direct impact on oil consumption. Engine oil that's too light will more readily find its way past gaskets and seals. This is especially true of synthetic oils. An oil that's too light works its way past the piston rings more readily, and is then burned in the combustion chamber.

Using a heavier weight oil to control oil consumption, however, is not necessarily the answer. An oil that's too heavy, can't get to all the internal engine components fast enough during engine start-up, allowing them to rub against each other without the benefit of lubrication. This increases wear during engine start-up—a time when engine wear is at its greatest.

Beyond an oil's weight, also consider its rating. Only use oils rated "SH," "SH/CC," or "SH/CD" by the American Petroleum Institute. A high-quality, 5W30 SH-rated engine

oil will provide excellent engine protection under most conditions.

Internal and External Oil Leaks

Oil leaks can be internal or external. Internal leaks are typically caused by worn piston rings, worn valve stem seals, and the like, whereas external leaks are usually the result of cracked, mispositioned, or hardened gaskets or seals. An external leak of only a few drops per mile can add up to a loss of a quart of oil for every few hundred miles driven. You need to find and eliminate all external oil leaks before condemning the engine to a rebuild.

Finding external leaks is much easier if you first degrease the engine. Foamy Engine Brite by Gunk seems to work best, but Simple Green by Sunshine Makers, Inc., works fairly well and is kinder to the environment. Whichever cleaning product you choose, it's best to scrape off any heavy deposits before applying the cleaner.

The engine can be cold or warm during the cleaning operation, depending on the cleaner you're using, but never hot. If you spray cold water on a hot engine, the resulting thermal shock could crack exhaust manifolds, cylinder heads, or even the block. Remember to remove the air cleaner and cover the carburetor and distributor with plastic freezer bags to avoid spraying water directly on them. Plug any hoses that were attached to the air cleaner so water doesn't end up where it shouldn't, and check that the dipstick is in place and fully seated.

After you've applied the cleaner, use a stiff-bristled brush to scrub any particularly dirty areas. Then rinse the engine with a strong stream of water. Repeat this process twice to ensure the engine's cleanliness. Remove any plastic bags, reinstall the air cleaner, and then run the engine to dry it off. After the engine is clean and dry, you have the choice of taking the low-, medium-, or high-tech route to leak detection.